

Design and Development Comparison of Rapid Cycle Amine 1.0, 2.0, and 3.0

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The development of the Rapid Cycle Amine (RCA) swing-bed technology for carbon dioxide (CO₂) removal has been in progress since favorable results were published in 1996. Shortly thereafter, a prototype was designed, developed, and tested successfully and delivered to Johnson Space Center in 1999. An improved prototype was delivered to NASA in 2006 and was notated as RCA 1.0 and sized for the extravehicular activity (EVA). The new RCA swing-bed technology is a regenerative system which employs two alternating solid-amine sorbent beds to remove CO₂ and water. The two-bed design employs a chemisorption process whereby the beds alternate between adsorption and desorption. This process provides for an efficient operation of the RCA so that while one bed is in adsorb (uptake) mode, the other is in the desorb (regeneration) mode. The RCA has now progressed through several iterations of technology readiness levels. Test articles have now been designed, developed, and tested for the advanced space suit portable life support system (PLSS) including RCA 1.0, RCA 2.0, and RCA 3.0. The RCA 3.0 was the most recent RCA fabrication and was delivered to NASA-JSC in June 2015. The RCA 1.0 test article was designed with a pneumatically actuated linear motion spool valve. The RCA 2.0 and 3.0 test articles were designed with a valve assembly which allows for switching between uptake and regeneration modes while minimizing gas volume losses to the vacuum source. RCA 2.0 and 3.0 also include an embedded controller design to control RCA operation and provide the capability of interfacing with various sensors and other ventilation loop components. The RCA technology is low power, small, and has fulfilled all test requirements levied upon the technology during development testing thus far. This paper will provide an overview of the design and development of RCA 1.0, 2.0 and 3.0 including detail differences between the design specifications of each.

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